Glass and Ceramics, Vol. 71, Nos. 3 – 4, July, 2014 (Russian Original, Nos. 3 – 4, March – April, 2014)

UDC 666.3:620.17:519.2

PAVERS FROM GLASS WASTES AND QUARTZ DUST

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Translated from *Steklo i Keramika*, No. 3, pp. 11 – 12, March, 2014.

It is shown that pavers at least as good as those based on clinker and significantly surpassing pavers based on fine-grain concrete can be obtained from glass wastes and quartz dust.

Key words: pavers, ground cullet, semidry pressing.

Modern public-works technologies and the focus on lowering the construction costs presuppose the use of environmentally clean and durable materials for paving roads instead of the conventionally used asphalt concrete. Many years of experience gained in European countries shows the efficacy of paving streets with small pavers. At present pavers are produced from natural stone (paving block), ceramic stone (clinker) and stone made from fine-grain concrete. The most durable pavers are paving blocks, but their production requires the development of quarries and expensive treatment of the stone which results in the production of considerable amounts of finely disperse wastes. One of the main factors preventing their use in the production of ceramic materials is the high sintering temperature (1500°C), which increases energy consumption significantly.

Pavers are produced from fine-grain concrete mainly because of the lower capital investments required, but the pavers themselves are not as durable as blocks and clinker.

The aim of the present work is to determine whether or not pavers can be made from industrial wastes, which perform at least as well as clinker.

Ground cullet and the wastes produced during the processing of quartz were used in this work. The chemical composition of the glass used is as follows (mass fraction of wastes, %): 71.8 SiO_2, 2.0 Al_2O_3, 4.1 MgO, 6.7 CaO, 14.8 Na_2O, 0.1 Fe_2O_3, and 0.5 SO_3.

The grain composition of the materials is presented in Table 1.

Quartz materials are used for pavers in combination with cullet because fine quartz particles will be centers of crystallization and will bring about partial crystallization of the molten glass.

Research has shown that the optimal firing temperature of the articles containing ground glass is 1000°C [1].

The optimal content of ground glass in the batch was determined on the basis of the maximum strength in compression of standard samples (see Fig. 1).

The research showed that the optimal content of ground glass in batch is 30%. For lower amounts of ground glass there is not enough melt to form a film around the quartz grains, which results in fewer sintering contacts. Above 30% ground glass the strength drops sharply as a result of an increase in the thickness of the glass film around the filler grains and a decrease in the degree of crystallization of the glass.

The characteristics of concrete and cullet based pavers are compared in Table 2.

It is evident from Table 2 that with respect to all indices the pavers prepared from glass-quartz batch by semidry pressing surpass the vibrationally compacted concrete based on Portland cement and are at least as good as clinker pavers. Concrete tiles are inferior to fired tiles with respect to perfor-

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TABLE 1. Grain Composition of the Initial Materials

Material	Residue mass fraction, %, on sieve *N*									
	2.5	1.6	0.63	0.4	0.315	0.2	0.16	0.063	0.05	bottom
Quartz dust	0	0	0	0	62.68	13.57	11.41	2.77	4.82	4.75
Quartz sand	32.57	45.58	17.04	1.93	0.44	0.42	0.28	0.81	0.18	0.73
Glass	0	0	0	0	0	0.59	0.17	0.22	0.62	98.39

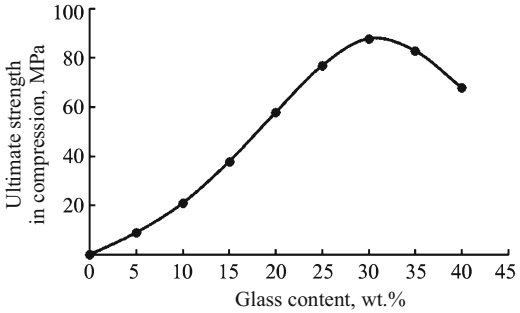

Fig. 1. Ultimate strength in compression of standard samples versus the glass content (by weight).

mance, including corrosion resistance. Clinker pavers are fabricated from high-quality clays at firing temperatures 1000 – 1500°C, which makes them more expensive than cullet-based pavers.

In summary, pavers prepared from glass-quartz batch by semidry pressing can be recommended for use.

TABLE 2. Comparative Characteristics of Pavers

Index	Clinker pavers [3]	Concrete-based pavers [2]	Cullet-based pavers
Density, kg/m^3	2010 – 2400	1600 – 2400	2410
Abrasion, g/cm^2	0.7 – 0.9	5	0.56
Strength in compression, MPa	40 – 100	40 – 60	88.1
Freeze resistance, cycles	100 – 300	200	> 300

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